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Relationships between IQ and Language Development Across Language Domains in Bilingual Children

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Relationships between IQ and Language Development Across Language Domains in Bilingual Children

by

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Dedication

I would like to dedicate this thesis to my mother and faster, Jesus and Chriselda, for continuously encouraging and supporting me through all of my endeavors, and most importantly, to my younger sister, Jessica, for inspiring me into the field of speech-language pathology and the topic of this thesis.

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Abstract

Relationships between IQ and Language Development Across Language Domains in Bilingual Children

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Abstract: The current study examined if Spanish-English bilingual children with extremely low IQ and average IQ demonstrated similar language development and which language variables were associated with increases or decreases in IQ development. Given the literature, we proposed the following hypotheses: children with extremely low IQ will demonstrate lower than expected language scores than their matched average IQ peer, and children that demonstrate increases in IQ across time will demonstrate increases in language scores. We examined two pairs of bilingual children matched on SES, bilingual status, and age. Despite variability in outcomes, we found a general increase in language measures, which suggests that measures utilized were not directly related to IQ development, but rather demonstrate a more general relationship between language domains and IQ.

Table of Contents

List of Tables ix

INTRODUCTION 1

Language Development in Children with Intellectual Disabilities 3

Bilingual Advantages on Nonverbal Tasks 4

The Present Study 7

METHOD 8

Participant Characteristics 8

Sampling Procedures 8

  Exclusionary/Inclusionary Criteria 9

Measures and Covariates 9

  Universal Nonverbal Intelligence Test 10

  Bilingual English Spanish Assessment 11

  Test of Narrative Language 11

  Inventory to Assess Language Knowledge (ITALK) 11

  Hollingshead Four-Factor Index of Socioeconomic Status (SES-Child) 12

Classification 12

Research Design 13

Materials 13

Experimental Manipulations 14

  Administration 14

RESULTS 15

Universal Nonverbal Intelligence Test 15

Bilingual English Spanish Assessment 16

  Semantics 16

Morphosyntax 16

Test of Narrative Language 17

DISCUSSION 20

Similarities in Language Development..20

Correlation of Language Abilities and IQ 21

Limitations 23

Future Research 23

References..25

List of Tables

Table 1: Participant Demographic Information 13

Table 2: UNIT Scores 15

Table 3: BESA Conceptual Percentage Scores..17

Table 4: TNL Scores 19

INTRODUCTION

The relationships between language and cognition have led to questions about the role of language functions in cognitive development and the interactions between language and cognition in individuals who know more than one language. Cognitive development encompasses the areas of thinking, problem-solving, memory and concentration. As one's cognitive development progresses, an individual may demonstrate increases in attention span, memory, and comprehension of complicated concepts (Patton, 1990). Piaget and Vygotsky are theorists who have substantially contributed to the study of cognitive development. Piaget theorized that children construct their own knowledge by acting on their own environment, however there is a cognitive development endpoint that occurs in adolescence (Papalia, Olds, & Feldman, 2011). Vygotsky's theory, on the other hand, placed more importance on how social and cultural factors contributed to cognitive growth. He theorized that individuals continuously learn throughout life through social development and scaffolding by adults and peers more capable of themselves. Though similar and opposing theories, both theorists have greatly contributed to the field of education by contributing explanations for cognitive learning abilities and styles in children. Thus, Vygotsky and Piaget created a foundation for much of the research and theory in cognitive development that has occurred over the past several decades.

Additional theories have been proposed to explain the relationships between language and cognition. The Generalized Slowing Hypothesis (Kail, 1994) is one, which assumes that the variation in a child's language ability is due to differences in their general cognitive ability, predicts that there are associations between nonverbal intellectual quotient (IQ) and language measures (Miller, Kail, Leonard, & Tomblin, 2001). In contrast to this view, the "competence-based" account, which associates language impairment with a localized linguistic deficit, predicts that there is a relative disassociation between general cognition and language, specifically in the morphosyntactic domain, as reported by Leonard (1998).

According to the World Health Organization (WHO), an intellectual disability is defined by "the presence of incomplete or arrested mental development, principally characterized by the deterioration of concrete functions at each stage of development and that contribute to the overall level of intelligence, such as cognitive, language, motor and socialization functions" (Katz & Lazcano-Ponce, 2008, p. 133). On the other hand, the American Association on Intellectual and Developmental Disabilities (AAIDD) describes intellectual disability similarly to the WHO's definition, but with additional deficits in two or more adaptive skills, which include communication, personal care, home life, social skills, utilization of the community, self-governance, health and safety, functional academic skills, leisure time, and work (Katz et al., 2008).

An IQ test is a standardized instrument used to characterize intellectual functioning by measuring an individual's mental age. Quotient scores are placed on a normal curve, where 120-129 indicates superior, 110-119 indicates high average, 90-109 indicates average, 80-89 indicates low average, 70-79 indicates borderline, and 69 and below indicates extremely low (Intelligence Quotient, 2001).

When considering language and cognitive development in children with intellectual disabilities, it is important to first comprehend how typically developing children acquire language. Children with intellectual disabilities typically display delays in language development. Typically developing children learn their first words roughly around 12 months of age and use two-word phrases by the 2 years. The first three years of life are the most intensive years for speech and language development and is also the time in which the brain develops and matures. By 4-5 years, children can hear and understand nearly everything that is said in their preschool classroom and at home, can speak clearly and fluently, and are learning to read. Complex language skills continue to develop through the elementary years (Siegal & Surian, 2011).

Language Development in Children with Intellectual Disabilities

Language development encompasses speaking, listening, reading, and writing, and thus communication involves understanding language and knowing how to use it, communicating one's wants and needs, and affects how one is able to follow directions. Reading and writing is also highly affected depending on one's level of communication. Individuals with intellectual disabilities may have a shorter attention span than their typically developing peers and may only be able to follow one or two-step directions (Patton et al., 1990). According to Memisevic and Hadzic (2013), children with intellectual disabilities have a high risk for developing a speech and/or language disability. When compared to their typically developing peers in regards to intellectual functioning, children with intellectual disabilities have a much higher prevalence (55% higher risk) at developing speech and/or language disabilities (Lesser & Hassip, 1986). Recalling and understanding abstract items in individuals with intellectual disabilities is often difficult, and they are more likely to recall and understand things that they can see or are familiar with (Patton et al., 1990).

Several studies have been conducted that compare language skills of children with intellectual disabilities to their typically developing peers. According to Van der Schuit, Segers, van Balkom and Verhoeven (2011), children with intellectual disabilities typically exhibit difficulties categorizing objects, which in turn hinders their lexical development. Although vocabulary development follows the same developmental pathways as typically developing children, their vocabulary level matches their mental age. Even though vocabulary size can be quite large in children with intellectual disabilities, difficulties are commonly seen in syntactic development. Caselli, Tonucci and Vicari (2000) analyzed vocabulary and morphosyntactic abilities in children with Down syndrome. Mean chronological age equaled 65.3 months and mental age equaled 30.6 months. Both language elements were found to be significantly delayed compared to their typically developing peers, although syntax was more delayed than their lexical abilities. Another language feature affected is phonological working memory (Jarrold & Baddeley, 1997; Van der Molen, Van Luit, Jongmans, & Van der Molen, 2007). When compared to their typically developing peers, Henry and MacLean (2003) found that children with intellectual disabilities demonstrated better performance on visuospatial memory tasks but word on word span tasks. The children with intellectual disabilities had a mean general conceptual ability score of 57.2 while typically developing children had a mean standard score of 103.8.

It is important to note that children with different etiologies of intellectual disabilities have differing speech and language disorders. For example, children with Down syndrome often have speech disorders but fairly intact pragmatic skills, while children with autism spectrum disorder and Fragile X syndrome exhibit traits of impaired pragmatics (Tager-Flusberg & Sullivan, 1994). Although autism spectrum disorder is commonly associated with intellectual disabilities, intellectual functioning varies from delayed to superior (Gallo, 2010).

Bilingual Advantages on Nonverbal Tasks

What it means to be bilingual has been a large topic of discussion amongst researchers because it largely affects how we study bilingualism and its effects on the area being studied (Bhatia & Ritchie, 2013). The definition of bilingualism has evolved throughout the years. For example, in 1933, Bloomfield (cited in Bhatia et al., 2013) reported that to be considered bilingual, you have to be proficient in your home language and foreign language. Later on, in 1953, Haugen defined bilingualism as the ability to use a foreign language in "complete and meaningful utterances" (cited in Bhatia et al., 2013, p.8). These reports are examples of how bilingualism used to be viewed as having equal competency in both languages whereas in recent years, bilingualism has been accepted as knowing two languages to some degree. This creates further complexity when studying bilingualism because researchers are now having to determine where the cutoff line stands. The basic areas of language, speaking, listening, reading and writing, further confound the study of bilingualism because, for instance, an individual's language skills may vary between these areas in both their dominant and foreign language.

Knowing more than one language has become increasingly prominent throughout the world as globalization continues to evolve (Bhatia & Ritchie, 2004). Approximately two-thirds of children in the world grow up in a bilingual environment, making bilinguals the majority and monolinguals the minority. Because of the large influence of bi/multilingualism on the world as a whole, it has been of significant interest and research has grown drastically (Bhatia et al., 2004). Bi/multilingual research has been conducted in theoretical and practical aspects in many fields, including but not limited to speech and language, hearing, psychology, education, and linguistics. A commonality between these fields has been their interest in bilingualism and its relation to the mind. According to Chomsky's theories on innate factors, he would not predict bilingualism to have any effect on the course of cognitive growth, but rather our cognition is related to our genetic makeup. Piaget, on the other hand, would have predicted that bilingualism has an effect on cognition since his theory states that cognition is influenced by one's environment.

Several studies have demonstrated that bilinguals have a tendency to score better or just as well than monolinguals on nonverbal tests. In Seidl's (1937) study, he used the Stanford-Binet scale as the verbal measure and the Arthur Point Scale of Performance as the nonverbal measure. His two groups, monolinguals and bilinguals, were matched on age and sex, but not on socioeconomic status. The bilingual group had lower socioeconomic scores than the monolingual group. He found that monolinguals overall performed better than the bilingual group on all verbal tests, but the bilingual group performed significantly better on performance measures. It is important to note that socioeconomic status has been repeatedly found to correlate to linguistic development and language (Jones, 1960; McCarthy, 1954). Thus, the lower performance of the bilingual group may have been due to their lower socioeconomic status and unrelated to intelligence.

Foy and Mann (2014) were interested in executive functioning of bilinguals versus monolinguals on nonverbal auditory tasks since most studies analyzing bilingual advantage use tasks that include visual stimuli rather than auditory stimuli. They found that in 5-year-old Spanish-English bilinguals compared to English-speaking monolinguals, the bilingual group had fewer errors and shorter reaction times on the auditory task but no differences on the verbal task.

A great deal of research on metalinguistic awareness was conducted during the 1970s and 1980s. In a couple of studies (Bialystok, 1988; Cromdal, 1999) monolingual and bilingual children were both able to identify grammatical errors in a meaningful sentence, which is a commonly used measure of metalinguistic functioning (Bialystok & Craik, 2010). However, when given a grammatical sentence with semantic violations (e.g., "Flowers grow on chairs."), bilingual children were more accurate at identifying grammatical errors than monolingual children. The findings in these studies on judging sentences signifies that bilingual children are better at executive functioning (attention in selectivity and inhibition) and does not back up the notion of a metalinguistic advantage in bilingual children.

According to Dethorne and Watkins (2006), there is conflicting empirical evidence regarding the relationships between language and nonverbal IQ and they suggest that it could depend on what aspect of language is being considered. Morphosyntax, for example has been predicted to be independent from cognitive abilities (Lenneberg, 1967; Keil, 1981; Cromer, 1988; Pinker, 1994). Semantics, on the other hand, has been proven to be correlated to IQ in typically developing children (Purcell et al., 2001; Young, Schmitz, Corley, & Fulker, 2001).

The Present Study

A great number of studies have investigated the relationships between intelligence and bilingualism, although there is lacking research specifically comparing language skills in bilingual children with low cognitive functioning to their typically developing peers with average intellectual functioning. The present study was designed to examine the effects of bilingualism on the intellectual functioning of children from kindergarten to third grade. The following two questions were addressed: (1) Do children with low IQ demonstrate similar language development to their age-matched peers with average IQ and similar language exposure? (2) Which language abilities (i.e., semantics, morphosyntax, narrative language) are correlated with IQ development? Given the literature, we proposed the following hypotheses: children with extremely low IQ will demonstrate lower than expected language scores than their matched average IQ peer, and children that demonstrate increases in IQ across time will demonstrate increases in language scores.

METHOD

Participant Characteristics

The current study approached four children between the ages of 4 and 6 years that were recruited from school districts in central Texas that serve a large number of bilingual Hispanic students. Participants consisted of three females and one male classified as Spanish-English bilingual based off of a teacher and parent questionnaire.

Sampling Procedures

Participants were selected from a larger ongoing study (i.e., Bilingual Outcomes) of 360 participants analyzing language performance across time in Spanish-English bilingual children. This former study followed its participants in two phases. In Phase 1, children in pre-kindergarten and kindergarten (between 4;6 and 5;6 years) were screened for language impairment in English and Spanish using the semantics and morphosyntax subtests from the *Bilingual English-Spanish Oral Screener* (*BESOS*), which was developed from the *Bilingual English-Spanish Assessment* (*BESA*; Peña, Gutiérrez-Clellen, Iglesias, Goldstein, & Bedore, 2014) and has a 90% classification accuracy. All participants were administered the *BESOS* in both English and Spanish whether they knew both languages or not. Participants were invited to Phase 2 if they scored below the 30^{th} percentile on either subtest of the *BESOS* (Peña et al., 2014) and were exposed to English by at least age 5.

Phase 2 participants from the Bilingual Outcomes project were classified as bilingual if they had at least 20% of input and output in both English and Spanish and functionally monolingual if 80% or more of input and output was in English. This information was collected via a questionnaire where guardians and teachers reported the participant's language exposure in

English and Spanish throughout a typical weekday and weekend, and their abilities in articulation, comprehension, sentence length, vocabulary, and grammar in each language (*BIOS/ITALK*, Peña et al., 2014). Children with a history of autism spectrum disorder, brain injury or severe social-emotional problems were excluded from Phase 2. During the first year of Phase 2, the participants were administered the *Universal Nonverbal Intelligence Test* (Bracken & McCallum, 1998), the semantic and Morphosyntax subtests from the *Bilingual English-Spanish Assessment Middle Extension* (*BESAME,* Peña et al., 2014), and the *Test of Narrative Language* (Gillam & Pearson, 2004). Participants of the current study were reassessed with follow-up testing three years post initial testing date. Data was collected by trained research associates in four one-hour sessions. Assessments were administered in a quiet setting at each participant's elementary school at a time specified by the teacher.

Exclusionary/Inclusionary Criteria

The current study targeted how many participants that received extremely low IQ scores (i.e., <70) on the *UNIT.* One of four participants was dropped due to "withdrew from district" status. These participants were then matched and paired with a typically developing peer with an average IQ score (i.e., >100) by similar age, language exposure, mother education (socioeconomic status), and bilingual status. All participants passed an initial or follow-up hearing test conducted by the school's nurse. Information on any received special services was not obtained.

Measures and Covariates

Participants completed the following tests in both English and Spanish: The morphosyntax and semantics subtests of the *BESA* and *BESAME* (Peña et al., 2014), the *Test of*

Narrative Language (TNL; Gillam & Pearson, 2004) and the *Universal Nonverbal Intelligence Test* (*UNIT*; Bracken & McCallum, 1998). Parents and teachers completed a language-use questionnaire as part of the *BESAME*.

UNIVERSAL NONVERBAL INTELLIGENCE TEST

The *UNIT* (Bracken & McCallum, 1998) is an assessment of cognitive abilities for children between the ages of 5;0 and 17;11 years and is administered nonverbally. It primarily measures memory and reasoning through six subtests, which include Symbolic Memory, Spatial Memory, Object Memory, Cube Design, Analogic Reasoning, and Mazes. For the purpose of the current study, the Symbolic Memory and Cube Design subtests were utilized. During the symbolic memory subtest, participants are shown a sequence of symbols for five seconds; the symbols are removed, and then the participant is required to reproduce the same symbols in the correct order with response chips. This subtest measures short-term visual memory and complex sequential memory for meaningful material. For the cube design subtest participants are shown an abstract design and are required to replicate the design using cubes with a constant stimulus. This subtest measures visual-spatial reasoning. The reliability coefficient for this assessment is .96, as reported from the *UNIT* manual.

It is important to mention that, even though the UNIT is a nonverbal test, there remains a level of linguistic demand. According to Ortiz (2001), "reducing the oral or spoken language requirements in any given test does not in fact eliminate potential linguistic bias and does little, if anything, to reduce bias related to acculturation" (p. 21). Based off of a linguistic demands matrix developed by Flanagan and Ortiz (2001), the cube design and symbolic memory subtests contain a moderate degree of linguistic demand.

Bilingual English Spanish Assessment

The *BESA* and *BESAME* (Peña et al., 2014) includes two questionnaires (ITALK) developed for teachers and parents where they are asked to report a child's exposure and use of English and Spanish at home and at school as well as concern. It also includes three subtests that assess semantics, morphosyntax, and phonology that combined are designed to reliably assess language development in Spanish-English bilingual children. For the current study, the phonology subtest was not utilized. The *BESA* assesses children between 4;0 to 6;11 years and the *BESAME* assesses children between 7;0 to 9;11 years. Each test was separately developed to follow the developmental language patterns of its age group. Sensitivity for semantics and morphosyntax is 81 and 92 respectively while specificity is 83 and 86 respectively.

Test of Narrative Language

The *TNL* (Gillam & Pearson, 2004) is a test that assesses the oral production and comprehension of narrative skills in children between the ages of 5;0 and 11;11. It consists of three narrative comprehension tasks and three production tasks (i.e., a story with no picture cues, a story with sequence picture cues, and a story with a single picture cue). The Spanish version was adapted from the English *TNL* but is not directly translated as to avoid structural similarities. This assessment identifies language impairments and measures how well children use language in a narrative context. It has high sensitivity (.92) and specificity values (.87).

Inventory to Assess Language Knowledge (ITALK)

The *ITALK* is a parent-teacher language-use questionnaire that is used to obtain subjective information from teachers and parents on a child's language use and exposure in English and Spanish. Parents and teachers are asked to provide an estimate of use and exposure each hour in a typical day at home and in the classroom. They are also asked to rate the child's ability in frequency of language use with peers and adults, vocabulary, speech, comprehension proficiency, sentence production, and grammaticality (Gutièrrez-Clellen & Kreiter, 2003).

HOLLINGSHEAD FOUR-FACTOR INDEX OF SOCIOECONOMIC STATUS (SES-CHILD)

The SES-Child (Hollingshead, 1975) is a survey that measures socio-economic status based on marital status, retired/employed status, educational attainment, and occupational prestige. It consists of a 7-point scale, from highest grade completed (7=graduate/professional training) to the lowest grade completed (2=junior high school; 1=less then 7^{th} grade).

Classification

Participants were divided into two individually analyzed pairs. Participants were paired based on IQ at the beginning of the study (one participant with a low IQ score and one with average IQ score in each pair), similar minimum age of first exposure to English, similar mother education, and similar age. Table 1 demonstrates each pair's IQ scores, Hollingshead scores, and age group at phase 2 year 1.

Table 1

Participant Demographic Information

Group	Participant	IQ Classification	Gender	Min Age Eng	Age Months	Ethnicity	SES (HH)
Group One	P1G1	Average	Male	4-5	63	Hispanic	2
Group One	P2G1	Extremely Low	Female	4-5	69	Hispanic	1
Group Two	P1G2	Average	Female	3-4	68	Hispanic	1
Group Two	P2G2	Extremely Low	Female	4-5	66	Hispanic	1

Note: P1G1 = participant one, group one; P2G1 = participant two, group one; P1G2 = participant one, group two; P2G2 = participant two, group two; Min Age Eng = minimum age exposed to English; SES (HH) = socioeconomic status, Hollingshead

Research Design

The research design of the current study is a case study that analyzes the differences in developmental language characteristics between children with low IQ and typically average IQ scores. Children were matched on age, SES, and minimum age exposed to English.

Materials

The materials used to implement the study consisted of *UNIT*, *TNL*, and *BESA/BESAME* test forms, an audio recorder, and teacher and parent questionnaire (*ITALK*) forms.

Experimental Manipulations

ADMINISTRATION

The English and Spanish versions of the *BESA, BESAME*, and *TNL* were administered as English only and Spanish only to their respective test. For the morphosyntax subtest of the *BESA*/*BESAME* and the oral comprehension portion of the *TNL*, the participant was required to respond in the language the test was administered in. For the semantics subtest and narrative comprehension portion of the *TNL*, participants were allowed to respond in either any language although the examiner was required to speak in the respective language of the test. All responses were audio recorded and scored on a hard copy of the assessment. All items were administered for the *BESA/BESAME* and *TNL*, however the tests were discontinued if the participant had no responses for the first five items. The *UNIT* was discontinued after three consecutive scores of 0. All scoring procedures adhered to each assessment's respective manual.

RESULTS

To address our two research questions, the following scores were compared: standardized scores from the UNIT; percentage scores from the semantics and morphosyntax subtests of the English and Spanish BESA and BESAME; Narrative Language Ability Index scores from the English TNL; conceptual percentage score for the Spanish TNL; number of different words, number of total words, and mean length of utterance in morphemes (MLUm) from the English and Spanish TNL.

Universal Nonverbal Intelligence Test

In Kindergarten all low IQ participants' (P2G1 and P2G2) UNIT scores fell within the extremely low range while the typically developing IQ participants' scores fell within the average to high average range. All low IQ participants experienced an increase in IQ scores from kindergarten to 3rd grade, while participants with typically developing IQ scores experienced a decline. At follow-up testing in the third grade, all participants' IQ scores fell within the "average" range, however, this decline was not significant enough to drop them below the "average" range. Furthermore, although P1G1 and P1G2 demonstrated a decline in scores, P2G1 and P2G2 continued to exhibit lower scores than their matched peers.

Table 2

UNIT Scores

		TD		Low IQ	
Variable		Grade K	Grade 3	Grade K	Grade 3
IQ	Group One	103	91	60	88
	Group Two	112	103	69	88

Note: TD = typically developing

Bilingual English Spanish Assessment

Conceptual percentage scoring was used to compare BESA and BESAME subtest scores. For the statistical analysis, associations rather than correlations were made because there was not a defined correlation coefficient that could measure the exact degree to which the variables tend to a certain pattern.

Semantics

All participants experienced an increase in conceptual percentage score for the English semantics subtest of the *BESAME* from kindergarten to third grade. Scores increased from 16% to 40.48% for P1G1, 16% to 47.6% for P2G1, 40% to 76.2% for P1G2, and from 36% to 71.42% for P2G2. For the Spanish semantics subtest, scores declined from 64% to 29.54% for P2G1 and from 80% to 47.73% for P1G1. Scores increased from 72% to 88.63% for P1G2 and from 44% to 56.81% for P2G2. Scores can be found in Table 2.

Morphosyntax

On the English version of the morphosyntax subtest, scores increased from 21.05% to 68.62% for P2G1, from 29.82% to 84.3% for P1G2, and from 50.88% to 85.29% for P2G2. A decrease in percentage score from 52.63% to 7.84% was seen for P1G1. For the Spanish morphosyntax subtest, scores increased from 57.69% to 58.33% for P1G1, from 32.69% to 33.33% for P2G1, from 69.23% to 75% for P1G2, and from 19.23% to 59.25% for P2G2.

Table 3

BESA Conceptual Percentage Scores

Variable		TD		Low IQ	
		Grade K	Grade 3	Grade K	Grade 3
Sem Eng % Correct					
	Group One	16%	40.48%	16%	47.60%
	Group Two	40%	76.20%	36%	71.42%
Sem Spn % Correct					
	Group One	80%	47.73%	64%	29.54%
	Group Two	72%	88.63%	44%	56.81%
Syn Eng % Correct					
	Group One	52.63%	7.84%	21.05%	68.62%
	Group Two	29.82%	84.30%	50.88%	85.29%
Syn Spn % Correct					
	Group One	57.69%	58.33%	32.69%	33.33%
	Group Two	69.23%	75%	19.23%	59.25%

Note: TD = typically developing; Sem Eng % Correct = semantics English percent correct; Sem Spn % Correct = semantics Spanish percent correct; Syn Eng % Correct = morphosyntax English percent correct; Syn Spn % Correct = morphosyntax Spanish percent correct

Test of Narrative Language

The Narrative Language Ability Index (NLAI) was used for the English TNL to obtain a composite index standard score. Conceptual percentage scores were calculated for the Spanish TNL since the test is currently awaiting publication and a composite index standard score has not yet been developed. English and Spanish number of different words, number of total words, and mean length of utterance in morphemes was also calculated.

NLAI scores in kindergarten and third grade fell within the <1 percentile for group one participants and for P1G2. P2G1 had NLAI scores of 52 and 55 in kindergarten respectively, and P1G1 had the same NLAI score of 52 in both grades. From kindergarten to third grade, English number of different words increased from 9 to 4 for P2G1, from 64 to 133 for P2G2, and 17 to 109 for P2G1. Scores decreased from 48 to 26 for P1G1. English number of different words increased from 9 to 83 for P2G1, 152 to 336 for P2G2, and 22 to 281 for P1G2. Scores decreased from 85 to 72 for P1G1. English mean length of utterance in morphemes increased from 3.33 to 5.5 for P2G1 and 5.75 to 10.27 for P1G2 and decreased from 9.59 to 7.83 for P2G2 and 5.75 to 10.27 for P1G2.

Conceptual percentage scores on the TNL increased from 7.8% to 21. 27% for P2G1, 27.75% to 35.46% for P2G2, and 31.2% to 63.12% for P1G2, while scores decreased for P1G1 from 46.1% to 38.29%. Spanish number of different words increased from 23 to 66 for P2G1, 74 to 90 for P1G1, 84 to 126 for P2G2, and 58 to 146 for P1G2. Spanish number of total words increased from 39 to 110 for P2G1, 178 to 208 for P1G1, 200 to 292 for P2G2, and 99 to 393 for P1G2. Spanish mean length of utterance in morphemes increased from 3 to 5.33 for P2G1 and 5.94 to 8.65 for P1G2, while scores decreased from 7.21 to 6.78 for P2G2 and from 9.3 to 7.13 for P1G1. Scores can be found in Table 3.

Table 4

TNL Scores

Variable		TD Grade K	TD Grade 3	Low IQ Grade K	Low IQ Grade 3
Eng NLAI					
	Group One	52	52	52	55
	Group Two	67	58	67	67
Eng # Diff Wds					
	Group One	48	26	9	49
	Group Two	17	109	64	133
Eng # TTL Wds					
	Group One	85	72	9	83
	Group Two	22	281	152	336
Eng MLUm					
	Group One	6.14	5.07	3.33	5.5
	Group Two	5.75	10.27	9.59	7.83
TNL Spn % Correct					
	Group one	46.10%	38.29%	7.80%	21.27%
	Group Two	31.20%	63.12%	27.65%	35.46%
Spn # Diff Wds					
	Group One	74	90	23	66
	Group Two	58	146	84	126
Spn # TTL Wds					
	Group One	178	208	39	110
	Group Two	99	393	200	292
Spn MLUm					
	Group One	9.3	7.13	3	5.33
	Group Two	5.94	8.65	7.21	6.78

Note: Eng NLAI = English narrative ability language index; Eng # Diff Wds = English number of different words; Eng # TTL Wds = English number of total words; Eng MLUm = English mean length of utterance in morphemes; TNL Spn % Correct = Test of Narrative Language Spanish percent correct; Spn # Diff Wds = Spanish number of different words; Spn # TTL Wds = Spanish number of total words; Spn MLUm = Spanish mean length of utterance in morphemes

DISCUSSION

The current study centers on questions examining language and cognition, as well as bilingualism's influence on cognition. This study reports on two questions related to the relationships found between children with low IQ and average IQ with similar language background, as well as relationships between language and cognitive development. Variability in bilingual children's language development was found between all participants, however findings cannot be generalized due to the study's limited number of participants.

Similarities in Language Development

We first investigated if there were similarities in language development between children with extremely low IQ and average IQ. Both participants with low IQ scores demonstrated an increase in English semantics, English morphosyntax, Spanish morphosyntax, and Spanish TNL conceptual percentage scores, while both participants with average IQ had increases in English semantics and Spanish morphosyntax. Variability was seen in all other measures.

In kindergarten, P1G1 had higher percentage scores than P2G1 on Spanish Semantics, English morphosyntax, Spanish morphosyntax, and all TNL measures. In third grade, performance differed between group one participants. P2G1 performed better than P1G1 on English Semantics and English morphosyntax, while P1G1 performed better on Spanish semantics and Spanish morphosyntax. Similarities in performance were also seen on TNL measures. P2G1 performed better than P1G1 on English TNL measures while P1G1 performed better than P2G1 on Spanish TNL measures. These differences in scores, however, are likely due to shifts in language proficiency. In kindergarten, when P1G1 had a significantly higher IQ than P2G1, the majority of P1G1's language scores were higher than P2G1, but as P2G1's IQ score improved to the same range as P1G1's, differences in scores became more related to language proficiency rather than difference in IQ.

In kindergarten, P1G2 had higher scores than P2G2 on English semantics, Spanish Semantics, and Spanish morphosyntax, however, the only TNL measure P1G2 performed better was on the TNL raw percentage. In third grade, performance remained the same for BESA scores, however performance on TNL differed. P2G2 performed better on English TNL measures, except for English MLUm, while P1G2 performed better on all Spanish TNL measures. In kindergarten, although P2G2 performed better on most TNL measures, these outcomes should be taken lightly. Various testing factors may have impacted each child's language sample, including but not limited to child's willingness to participate or shy demeanor, specifically because P1G2 had a better Spanish TNL raw percentage score even though language sample measures were below P2G2's. As with group one, differences in scores in the third grade appear to be more related to language proficiency rather than difference in IQ. The patterns seen between participants supports Kail's generalized slowing hypothesis (1994). As participants with low IQ experienced an increase in IQ, there was an overall increase in language measures; as participants with average IQ experienced a slight decline in IQ, their changes in score were more variable. Thus to address our first question, both groups demonstrated similar language development patterns on English semantics and Spanish morphosyntax.

Correlation of Language Abilities and IQ

The current study also investigated which language abilities were correlated with IQ development. We found that as P1G1's IQ score decreased, so did scores in Spanish semantics, English morphosyntax, English number of different words, English number of total words, Spanish TNL raw percentage, English MLUm and Spanish MLUm. For P2G1, as IQ increased, so did scores for English semantics, English morphosyntax, Spanish morphosyntax, English NLAI, English number of different words, English number of total words, Spanish TNL raw percentage, Spanish number of different words, Spanish number of total words, English MLUm, and Spanish MLUm. The only variable that did not demonstrate an increase in score was Spanish semantics. As P1G2's IQ score decreased, there was also a decrease in English NLAI. All other variables increased. For P2G2, as IQ increased, scores also increased for English semantics, Spanish semantics, English morphosyntax, Spanish morphosyntax, English number of different words, English number of total words, Spanish TNL raw percentage, Spanish number of different words, and Spanish number of total words. Decreases in scores were seen in Spanish and English MLUm while English NLAI remained the same. Overall, a general growth in language development was noted despite the mentioned patterns. This generalized finding suggests that the TNL and BESA are not specifically related to IQ development, but a more generalized relationship is suspected following the patterns found.

Both participants with low IQ at the entrance of the study demonstrated an increase in IQ score during follow-up testing in third grade. In association with an increase in IQ scores, both participants demonstrated an increase in English Semantics, English morphosyntax, Spanish morphosyntax, English number of different words, English number of total words, Spanish TNL raw percentage, Spanish number of different words, and Spanish number of total words. Both participants with average IQ at the entrance of the study demonstrated a decrease in IQ scores, although scores continued to remain in the average range. A pattern in which both participants demonstrated a decrease in any variable was not noted, however, both participants demonstrated an increase in English semantics, Spanish morphosyntax, Spanish number of different words, and Spanish number of total words. Thus, to address our second question, a conclusive correlation between language measures and IQ development was not found between all of the participants. Despite variability in outcomes, we found a general increase in language measures, which suggests that measures utilized were not directly related to IQ development, but rather demonstrate a more general relationship between language domains and IQ. Furthermore, associations between IQ and language development were tighter within testing points versus across testing points, further supporting the finding that there was a less conclusive relationship between language measures and IQ development across time while associations were seen between participants at specific testing points.

Limitations

The current study had a limited sample size, with only four participants total. Therefore, there is some degree of uncertainty associated with the outcome values and associations rather than correlations between participants were obtained. A larger sample size would have increased the degree of certainty and the utility of calculations of correlations may have been able to be utilized. Furthermore, the TNL was normed on monolingual children and thus NLAI scores should be interpreted with caution. An added limitation is that there were only two testing points throughout the study. An additional testing point would have further delineated the patterns of outcomes. Additionally, only two subtests of the UNIT were utilized in this study. Incorporating all subtests would have provided a more stable measure of intelligence.

Future Research

Future research should incorporate monolingual children in order to compare language outcomes between bilingual and monolingual children and how knowing more than one language may affect cognitive development. According to research, bilingual children often exhibit a metalinguistic advantage over monolingual children, and thus it would be important to distinguish IQ development based on this finding. Since the current study generated general rather than conclusive outcomes, future research should also attempt to compare language and IQ development in children with a wider range of IQ scores in order to further understand this relationship.

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